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A RECORD OF TANOAK ACORN AND SEEDLING PRODUCTION IN NORTHWESTERN CALIFORNIA

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Tanoak (Lithocarpus densiflorus (Hook. and Arn.) Rehd.) is an aggressive hardwood which attains maximum development in Humboldt and Mendocino Counties, California. A common associate of commercial conifers, it assumes two forms in virgin forests. Tanoaks may be tall trees with straight trunks which are clear of limbs for 30 to 80 feet. Or they may form shrubby undergrowth which endures remarkably well in the shade.

When the conifers are harvested, tanoak shrubs respond to release after logging and often dominate an entire cutover. And if logging or slash fires destroy the aerial parts of either trees or shrubs, the vigorous root systems produce new fast-growing sprouts. 1/

Are residual tanoak trees also able to establish new trees by seeding-in cutover ground? The purpose of this study was to find answers to these questions.

The Study

The study consisted of two parts. First, we collected acorns and examined them to learn something about seed abundance and quality. Second, we counted and measured tanoak seedlings to find how many the acorn crop produced and how fast they grew.

Eight tanoaks growing on the Brush Mountain Unit, Six Rivers National Forest, near Salyer, California, were chosen for the study. These trees varied from 18 to 26 inches in diameter. They were growing on soil more than 3 feet deep which was classified as Hugo clayey loam.

1/ Roy, D. F. Hardwood sprout measurements in northwestern California. U. S. Forest Serv. Calif. Forest and Range Expt. Sta. Forest Res. Note 95, 6 pp., illus. 1955.

The California Forest and Range Experiment Station is maintained at Berkeley in cooperation with the University of California.

The ground sloped toward the east at an average rate of 40 percent, and the elevation ranged between 2,400 and 2,500 feet. Logging of the Douglas-fir stand in 1952 had prepared seedbeds of loose mineral soil.

The Acorn Crop

We knew that tanoaks produce abundant seed crops. Trees are heavily laden almost every other year, and complete seed crop failures are rare. However, insects destroy many acorns. To estimate the amount of sound tanoak acorns, we collected samples from the ground under three trees chosen without prejudice from the eight tanoaks selected for the study. The acorns were gathered November 14, 1953.

We sampled quantity by selecting ten 1-foot square areas at random under each tree and counting the acorns lying on the ground within these areas. Sampling was restricted to a circular area 1/20th of an acre in size (radius equal to 26.3 feet) because the heavy acorns fall straight to the ground and most remain under the crown of the tree. Acorns were collected at rates from 78,408 to 91,476 per acre--an average of 84,216 per acre (table 1).

To get some idea of the quality of tanoak acorns, we collected additional samples from the ground under the same trees where the quantity of seedfall was sampled. Examination of the acorns showed that insects destroyed a significant amount--51 percent of all acorns collected (table 2).

The acorns were stored about 2 weeks before they could be examined. During this period coleopterous and lepidopterous larvae emerged from them. Several larvae were given to the entomologists 2/ who attempted to rear adults which could be positively identified. One adult beetle, the filbert weevil (Curculio uniformis (Lec.)), emerged in the rearing cages. Two moths matured. They were the filbertworm (Melissopus latiferreanus (Wlsm.)), and a grey moth similar to Valentinia glanulella (Riley) which was tentatively identified as Holcocera sp. An adult ichneumon fly (Pimplopterus dakrumae (Ashm.)), which is probably an insect parasite rather than an acorn pest, also emerged.

Tanoak Seedlings

To find how effectively the tanoak acorn crop produced seedlings, we counted the seedlings on a 1/20th-acre plot under each of

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2/ Division of Forest Insect Research, Calif. Forest and Range Expt. Sta.

Table 1.--Number of acorns under tanoak trees, Brush Mountain Unit, Six Rivers National Forest, near Salyer, California, 1953

Sample number	Acorns found on square foot samples		
	Tree 1	Tree 4	Tree 6
	Number		
1	1	1	5
2	2	4	1
3	5	6	0
4	0	0	3
5	3	3	1
6	4	1	2
7	0	3	2
8	2	0	1
9	0	1	0
10	2	2	3
Total	19	21	18
Number per acre under trees	82,764	91,476	78,408
D.b.h.-inches	18.3	22.2	23.9

Table 2.--Tanoak acorns destroyed by insects, Brush Mountain Unit, Six Rivers National Forest, near Salyer, California, 1953

Tree number	D.b.h.	Acorns collected	Acorns destroyed by insects	
	Inches	Number	Number	Percent
1	18.3	240	65	27
4	22.2	250	206	82
6	23.9	347	153	44
All	--	837	424	51

the 5 tanoaks from which the seed crop was not sampled the preceding fall. Since tanoak germination is hypogeous, the small trees were pulled from the soil to make sure they were really seedlings and not root sprouts. Heights from the cotyledons to the growing tips also were measured. The seedlings were counted and measured July 22, 1954.

The numbers of seedlings found on 1/20th-acre plots varied between 8 and 19, and averaged 13, or an average of 264 seedlings per acre (table 3).

The efficiency of the crop of sound acorns in producing seedlings was low. It was calculated by dividing the average number of seedlings per acre by the average number of sound acorns falling per acre:

$$\frac{264}{84{,}216 \times .49} = 0.64 \text{ percent}$$

Biotic factors may have contributed to the low seed crop efficiency. We know several birds and mammals eat tanoak acorns: The California woodpecker (Balanosphyra formicivora bairdi (Ridgway)), band-tailed pigeon (Columba fasciata fasciata Say), blue-fronted jay (Cyanocitta stelleri frontalis (Ridgway)), Pacific varied thrush (Ixoreus naevius naevius (Gmelin)), Townsend chipmunk (Eutamias townsendii Bachman), dusky-footed wood rat (Neotoma fuscipes fuscipes Baird), Douglas ground squirrel (Otospermophilus grammurus douglasii (Richardson)), redwood chickaree (Sciurus douglasii mollipilosus (Audubon & Bachman)), California gray squirrel (Sciurus griseus griseus Ord.), American black bear (Euarctos americanus americanus (Pallas)), and Columbian black-tailed deer (Odocoileus hemionus columbianus (Richardson)). 3/ Low germinative capacity also may have been a factor. A germinative capacity as low as 19 percent has been reported for tanoak acorns. 4/

The height of the tanoak seedlings, measured from cotyledons to growing tip, varied from 1.9 to 8.3 inches, and averaged 5.2 inches. Since we measured the trees on July 22, total first-year growth might have been more. Even the heights in July, however, were greater than first-year height growth of conifers on the same site. All tanoak seedlings were vigorous (fig. 1).

3/ Letters from Lloyd P. Tevis, Jr., dated February 13, 1957, and Donald C. Hagar, Jr., dated February 26, 1957.

4/ U. S. Forest Service. Woody plant seed manual. U. S. Dept. Agr. Misc. Pub. 654, 416 pp., illus. 1948.

Figure 1.--Tanoak seedlings collected from a 1/20th-acre plot under a tanoak tree 19.5 inches in diameter breast height. By July 22 these seedlings ranged in height from 2.1 to 6.8 inches, and averaged 4.4 inches tall. Brush Mountain Unit, Six Rivers National Forest, near Salyer, California, 1954.

Table 3.--Number and heights of tanoak seedlings from 1953 acorn crop, 1/20th-acre plots, Brush Mountain Unit, Six Rivers National Forest, near Salyer, California, July 22, 1954

Tree number	D.b.h.	Seedlings		Heights of Seedlings	
		Per plot	Per acre	Range	Average
	Inches	Number		Inches	
2	23.5	12	240	2.9--8.3	5.5
3	19.5	11	220	2.1--6.8	4.4
5	24.7	16	320	2.7--7.1	5.1
7	26.4	19	380	1.9--7.9	6.1
8	20.3	8	160	2.0--6.6	4.0
All	22.9	13	264	1.9--8.3	5.2

Summary and Conclusions

Tanoak acorns were collected and examined to learn about amount and quality of seedfall. The number of acorns found under tanoak trees from 18 to 24 inches in diameter at breast height averaged 84,216 per acre. Of these, 51 percent were destroyed by insects, leaving 41,266 sound acorns per acre.

The acorn crop, although only 0.64 percent efficient, established seedlings at the rate of 264 per acre. By July of the first growing season heights of the tanoak seedlings ranged from 1.9 to 8.3 inches, and averaged 5.2 inches. All tanoak seedlings were vigorous.

We conclude that residual tanoaks produce seedlings capable of controlling forest land. Although the 1953 acorn crop did not produce seedlings efficiently, some were established. Since tanoaks consistently produce acorn crops, we can expect more seedlings each year. Because young tanoaks grow vigorously, they might capture the ground under parent trees, especially if Douglas-fir seed crops fail. The amount of ground captured by tanoak seedlings will depend upon the number of tanoaks left after logging.